

REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. In particular, noting that claim 12, in the Preliminary Amendment filed January 9, 2006, deleted recitation of the coating film, Applicants have cancelled claim 14 without prejudice or disclaimer, and have substituted therefor new claim 25. Claim 25 recites subject matter set forth in previously considered claim 14, but is dependent on claim 23 (which recites a coating film made by the method of claim 12).

In addition to claim 25, Applicants are adding new claims 26 and 27 to the application. Claim 26, dependent on claim 1, further defines the photo-base generator, as being capable of generating at least one of specified compounds upon irradiation of ultraviolet rays, consistent with the description on page 4, lines 13-18, of Applicants' specification. Claim 27, also dependent on claim 1, further defines the anion X⁻, deleting the dimethyldithiocarbamate anion from the listed anions for X⁻ in claim 1.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed May 24, 2007, that is, the U.S. patent documents to Amagai, et al., Patent No. 5,807,975 (Amagai '975), to Amagi, et al., Patent No. 5,945,504 (Amagi '504), and to Ishii, et al., Patent Application Publication No. 2003/0195270, Japanese Patent Document No. 11-071521 (Torigoe, et al.), and the article by Tachi, et al., "Photochemical Reactions of Quaternary Ammonium Dithiocarbamates as Photobase Generators and Their Use in the Photoinitiated

Thermal Crosslinking of Poly(glycidyl methacrylate)", in J. Polymer Science Part A, Vol. 39 (2001), pages 1329-41, under the provisions of 35 USC 103.

It is respectfully submitted that the references as applied by the Examiner would have neither disclosed nor would have suggested such a photocurable composition as in the present claims, having, in addition to an episulfide compound containing a thiirane ring, a photo-base generator represented by the general formula (1) as in claim 1, with (-A⁺) being an ammonium ion selected from the group consisting of those represented by the structural formulae (2), as set forth in claim 1.

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a photocurable composition as in the present claims, having features as discussed previously in connection with claim 1, and, moreover, wherein X⁻ of the structural formulae (2) is selected from the group consisting of borate anion, an N,N-dimethylcarbamate anion, a thiocyanate anion and a cyanate anion (see claim 27), in particular, wherein X⁻ is a borate anion (see claim 3).

Furthermore, it is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such photocurable composition as in the present claims, having features as discussed previously in connection with claim 1, and, in addition, wherein the photo-base generator is capable of generating at least one of the specified compounds recited in claim 26, upon irradiation of ultraviolet rays.

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such photocurable composition

as in the present claims, having features as discussed previously in connection with claim 1, and, furthermore, having additional features as in the dependent claims reciting the photocurable composition, including (but not limited to) wherein Ar is further defined as in claim 2; and/or wherein the compound (A) is a compound having at least one structure represented by the structural formula (3) in claim 4, more specifically, wherein the compound (A) is represented by the general formula (4) as in claim 5, with the integers n and m being that set forth in claim 6; and/or wherein the composition further includes a solvent capable of dissolving the photo-base generator, as set forth in claim 7.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested a method for curing the photocurable composition discussed previously in connection with claim 1 or 7, by irradiation of ultraviolet rays (see claims 8 and 16), or wherein the composition is cured in the absence of air (see claims 9 and 19).

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such cured product as in the present claims, made by the methods of claim 8 (note claim 15), of claim 16 (note claim 17), of claim 9 (note claim 18), or of claim 19 (note claim 20).

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a coating composition as in the present claims, including the photocurable composition as in claim 1 or 7, and (C) a modified silicone oil (note claims 10 and 21), and (D) a silane coupling agent (note claims 11 and 22); and/or a method of curing the coating

composition by irradiation of ultraviolet rays (note claims 12 and 13), particularly with such irradiation occurring in the absence of air (note claim 13); and/or the cured or optical product made by the aforementioned method, as in claims 23-25.

The present invention relates to photocurable compositions and coating compositions useful for producing various optical products such as optical adhesives, optical coating materials, optical fibers, filters and plastic lenses, among other products.

Plastic materials have been recently used as various optical materials because of light weight, high tenacity and easy-dyeability. Various methods for photocuring episulfide compounds have been disclosed, as described in the paragraph bridging pages 1 and 2 of Applicants' specification.

Moreover, as will be discussed further infra, a photobase generator which is a quaternary ammonium salt with N,N-dimethyldithiocarbamate has been described as a photobase generator for photo-initiated thermal crosslinking of poly(glycidyl methacrylate).

Furthermore, episulfide compounds have previously been cast into a so-called mold and then polymerized and cured therein to obtain a cured product thereof. Owing to the remarkably high refractive index of these episulfide compounds, there is a strong demand for applying the episulfide compounds as a coating material for various substrates. However, since coating materials made of the episulfide compound generally exhibit a poor wetting property to various substrates, it is difficult to stably form a thin film having a thickness of from several μm to several tens μm , of the episulfide compound.

Against this background, Applicants have solved the foregoing problems by the present invention. Specifically, Applicants have found that by using a photo-base generator represented by the general formula (1) with an episulfide compound containing a thiirane ring, an episulfide compound capable of being readily cured by irradiation of ultraviolet rays, and having a high refractive index, is achieved; and, moreover, a coating material containing the episulfide compound and capable of being readily cured by irradiation of ultraviolet rays, and having a high refractive index, can be achieved. See, e.g., the paragraph bridging pages 2 and 3 of Applicants' specification.

Applicants have further found that when the thiirane ring-containing compound is that set forth in formula (3) (note claim 4), the resultant photocurable composition is more suitable as a photocurable composition since a cured product obtained therefrom can exhibit a higher refractive index. See, e.g., the paragraph bridging pages 3 and 4 of Applicants' specification.

In addition, Applicants have found that by adding a modified silicone oil to this photocurable composition including the specified episulfide compound and the specified photo-base generator, the composition is suitable as a coating composition since the composition shows a good wetting property to various substrates. See page 4, lines 5-9, of Applicants' specification.

Moreover, Applicants have found that by including a silane coupling agent in the coating composition, a coating film having excellent uniformity and adhesion property is achieved, as described in the paragraph bridging pages 19 and 20 of Applicants' specification.

As to advantages achieved by the present invention, attention is respectfully directed to the Examples and Comparative Examples on pages 22-36 of Applicants' specification. Attention is particularly directed to Examples 1-8 and Comparative Examples 2-5, on pages 23-26 of Applicants' specification, further described in Table 1-1 on page 27 of Applicants' specification, together with the results shown in Table 1-2 on page 28 of Applicants' specification. It is respectfully submitted that this evidence in Applicants' specification must be considered in determining patentability of the presently claimed subject matter. See In re DeBlauwe, 222 USPQ 191 (CAFC 1984). Properly considered, it is respectfully submitted that this evidence shows unexpectedly better results achieved by the present invention, utilizing the photo-base generator recited therein, as compared with using other photo-initiators, and clearly supports patentability of the presently claimed subject matter.

Amagai '975 discloses alkyl sulfide type episulfide compounds which can be suitably used as an optical material, the episulfide compounds being represented by general formula (I) or (II) as set forth most generally in column 3, lines 1-16, of this reference. This patent discloses that an optical material is obtainable by polymerizing and curing an alkyl sulfide type episulfide compound represented by the general formula (I) or (II). Note column 3, lines 47-50. See also column 3, lines 54-63. This patent goes on to disclose that the described episulfide compounds can be polymerized/cured in the presence of a curing catalyst to prepare an optical material, any of the known curing catalysts for epoxy resins being used (see column 9, lines 51-57); and that the alkyl sulfide type episulfide compound can be cured/polymerized with a compound having two or more functional groups which can react with an episulfide group, or a

compound having one or more of these functional groups and one or more of other homopolymerizable functional groups (see column 12, lines 6-17).

While generally disclosing polymerizing/curing of the episulfide compound, it is noted that, e.g., in Example in columns 13 and 14 of this patent, the polymerization/curing was performed at a relatively high temperature of 80°C. It is respectfully submitted that this reference does not specifically disclose, nor would have suggested, such composition as in the present claims, or the curing method or product produced, including the photo-base generator forming part of the composition, and/or wherein the curing is performed using ultraviolet radiation.

It is respectfully submitted that the secondary references as applied by the Examiner would not have rectified the deficiencies of Amagai '975, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Tachi, et al. reports on photo products of quaternary ammonium dithiocarbamate and their application to photo-initiated thermal crosslinkers for poly(glycidyl methacrylate) (PGMA). Note, in particular, the first paragraph in the left-hand column on page 1330 of this article. In summary, this article discloses that the quaternary ammonium salts with phenacyl groups and N,N-dimethylthiocarbamate anions are good photobase generators, for PGMA, that produce tertiary amines. Note the "SUMMARY" in the left-hand column on page 1341 of this article.

Initially, it is emphasized that the article discloses quaternary ammonium salts with N,N-dimethylthiocarbamate are photobase generators for photo initiated thermal crosslinking of poly(glycidyl methacrylate). This article does not disclose any effect of

the crosslinking agent on optical properties, Tachi, et al. not disclosing optical properties at all. Noting that Amagai '975 specifically discloses thermal curing, and that the article by Tachi, et al. does not mention at all an optical material, e.g., having high refractive index, or even episulfide compounds, much less episulfide compounds having a thiirane ring, it is respectfully submitted that one of ordinary skill in the art concerned with in Amagai '975 would not have looked to the teachings of Tachi, et al. In other words, it is respectfully submitted that these references are directed to non-analogous arts.

Moreover, it is respectfully submitted that the Examiner has pointed to no proper reason, based upon the teachings of the applied references to one of ordinary skill in the art, for applying the teachings of Tachi, et al. to the teachings of Amagai '975. In this regard, it is respectfully submitted that only through hindsight use of Applicants' invention, which of course is improper under the requirements of 35 USC 103, would one of ordinary skill in the art have applied the teachings of Tachi, et al. to Amagai '975.

Furthermore, it is again emphasized that Tachi, et al. is directed to photo initiated thermal crosslinking for poly(glycidyl methacrylate). It is respectfully submitted that episulfide compounds as in Amagai '975 are quite different in properties than poly(glycidyl methacrylate). Thus, "S" is quite different from "C" in properties thereof, because they belong to different groups. Furthermore, the episulfide compound as in the present claims has a thiirane ring, whereas poly(glycidyl methacrylate) in Tachi, et al. does not have a thiirane ring. Particularly in view thereof, it is respectfully submitted that there would have been no reason for one of ordinary skill in the art concerned with in Amagai '975 to have looked to the teachings of Tachi, et al., absent the description in

Applicants' disclosure of their invention, which of course cannot provide a reason for combining teachings of references.

On page 3 of the Office Action mailed May 24, 2007, the Examiner recognizes that Amagai '975 "[fails] to disclose the photobase generator of formula (1) in claim 1 of the instant application", but notes that Tachi, et al. discloses a process of curing poly(glycidyl methacrylate) and the use of quaternary ammonium salts of formula (I) as photobase generators. The Examiner goes on to state in the first paragraph on page 4 of the Office Action mailed May 24, 2007, that it would have been obvious to use the quaternary ammonium salts disclosed Tachi, et al. as curing catalyst/photobase generators for the episulfide compounds with thirane rings of Amagai '975, "based on Amagai's teachings that any curing catalyst used for curing epoxy products can be used to cure the episulfide compounds", the Examiner pointing to column 9, lines 54-56 of Amagai '975.

However, as mentioned previously, the episulfide compound is quite different from the poly(glycidyl methacrylate) in Tachi, et al., from a view point of chemical structure; and, moreover, Tachi, et al. does not discuss optical materials, much less optical materials having high refractive index. It is respectfully submitted that one of ordinary skill in the art, e.g., for optical materials, even with the teachings of Amagai '975 and Tachi, et al., would not have looked to application of Tachi, et al. to episulfide compounds having a thirane ring, even in light of the disclosure at column 9, lines 54-56, of Amagai '975.

Particularly in view of the unexpectedly better results achieved according to the present invention, utilizing the composition (that is, combination of compounds) as in the

present claims, any conclusion as to prima facie case of obviousness established by combining the teachings of Amagai '975 and Tachi, et al. is overcome.

Moreover, clearly the combined teachings of Amagai '975 and of Tachi, et al. would have neither taught nor would have suggested the compositions with anions X⁻ as in claims 3 and 27.

It is respectfully submitted that the additional teachings of the additionally applied secondary references would not have rectified the deficiencies of the combined teachings of Amagai '975 and of Tachi, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Amagi '504 discloses an episulfide compound having two or more moieties represented by a specified formula and having a cyclic skeleton, as described most generally from column 2, line 65 through column 3, line 2. This patent further discloses that the episulfide compound can be polymerized/cured with a compound having two or more functional groups capable of reacting with the episulfide group, a compound having one or more of these functional groups and one or more other homopolymerizable functional groups, or a compound having one functional group which can react with the episulfide group and which is further homopolymerizable, thereby preparing an optical material. Note column 10, lines 6-29. This patent further discloses, in the paragraph bridging columns 14 and 15 of this patent, that before or after mixing of the respective materials and additives, a degassing operation may be carried out under reduced pressure, and this operation is preferable to prevent formation of air bubbles during subsequent cast polymerization.

Even assuming, arguendo, that the teachings of Amagi '504 were properly combinable with the teachings of Amagai '975 and Tachi, et al., with or without teachings of additional references discussed infra, and even assuming, arguendo, that the teachings of Amagai '975 and Tachi, et al. were properly combinable, such combined teachings would have neither disclosed nor would have suggested the presently claimed composition or method of use thereof, including use of the specified photo-base generator with the episulfide compound containing a thiirane ring, and advantages thereof. Moreover, it is emphasized that Amagi '504 discloses that before or after the mixing, the degassing operation may be carried out under reduced pressure. It is respectfully submitted that such disclosure would have neither taught nor would have suggested the present invention, including curing the composition in the absence of air.

Torigoe, et al. discloses a lubricant and mold-releasing composition that retains good lubricity, mold-releasing properties, heat-resistance and safety intrinsic to silicone material, manifesting excellent adhesion to other materials and being useful in the field of electrophotography, the composition including (A) a reactive silane compound and (B) silicone-oil, when necessary, in addition a mold-releasing agent such as a silicone resin, a fluororesin or polyethylene or bee wax and a solid lubricant such as boron nitrite, graphite or molybdenum disulfide.

It is noted that Torigoe, et al. discloses a mold-releasing composition. It is respectfully submitted that one of ordinary skill in the art concerned with in Amagai '975, directed to episulfide compounds and optical materials formed therefrom, would not have looked to the mold-releasing composition of Torigoe, et al.

In any event, even assuming, arguendo, that the teachings of Torigoe, et al. were properly combinable with the teachings of the other references as applied by the Examiner, such combined teachings would have neither disclosed nor would have suggested the coating composition or method of use thereof, or the coated product formed using such coating composition, as in the present claims, including the modified silicone oil and/or silane coupling agent, and advantages thereof as discussed previously.

Ishii, et al. discloses sulfur-containing polyenic compounds, and photocurable compositions containing this compound and a sulfur-containing polythiol compound. The composition is described most generally in paragraphs [0010] and [0011] on page 1 of this published application, described as invention 1, with paragraph [0017] on page 2 disclosing that the invention 1 further provides a cured product of the above composition and an optical material obtained from the cured product. In paragraphs [0018] and [0019] on page 2 of this publication, invention 2 is described as providing a sulfur-containing polyenic compound represented by the formula (15). Note also paragraph [0050] on page 5 of this published application, describing photoradical polymerization initiators in connection with the invention 1. As applied by the Examiner, note paragraph [0119] on page 21, disclosing a method of molding the cured product obtained by polymerizing the polymerizable composition of invention 2.

It is emphasized that Ishii, et al., as applied by the Examiner, discloses a molding composition and method of invention 2, that is, a composition and method including the compound of formula (15). The same disclosure as made in connection with invention 2, is not made in connection with invention 1 of Ishii, et al. It is respectfully submitted

that this reference would have neither disclosed nor would have suggested, and in fact would have taught away from, such coating composition or method of use thereof, or product formed therefrom, as in the present claims, including the optical product as in claim 25, formed from the composition of claim 1, or unexpectedly better advantages due thereto, as discussed previously. Moreover, as discussed previously, the teachings of Ishii, et al. would not have rectified deficiencies of the teachings of the other applied references, in connection with teaching or suggesting a composition including both the episulfide compound containing a thirane ring, and the specified photo-base generator, and advantages achieved thereby.

The contention by the Examiner with respect to "product-by-process" recitations, in, e.g., claims 15, 17, 18, 20, 23 and 24, is noted. It must be emphasized, however, that where the processing provides a different structure, such processing must be considered in determining patentability. See In re Luck, 177 USPQ 523, 525 (CCPA 1973). As discussed previously, the cured product formed from, inter alia, the episulfide compound and the photo-base generator, is different from that in the teachings of the applied references, and it is respectfully submitted that such product must be considered in determining patentability of the cured product.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

To the extent necessary, Applicants hereby petition for an extension of time under 37 CFR 1.136. Kindly charge any shortage of fees due in connection with the filing of this paper, including any extension of time fees, to the Deposit Account of

Antonelli, Terry, Stout & Kraus, LLP, Account No. 01-2135 (case 396.45781X00), and
please credit any overpayments to such Deposit Account.

Respectfully submitted,

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